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regions: the case of Hungary 2000-2009**

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Abstract: A growing body of literature shows that related diversification in regions is more common but unrelated diversification also happens. However, we have little understanding of what types of firms induce related and unrelated diversification in regions. We investigate the extent to which foreign-owned firms induce structural change in the capability base of 67 regions in Hungary between 2000 and 2009. Doing so, we aim to connect more tightly the disparate literatures of Evolutionary Economic Geography and International Business. Using novel methodology developed by Neffke et al. (2018), we find that foreign-owned firms show a higher deviation from the region's average capability match than domestic firms, and therefore, tend to contribute more to structural change in regions.

Keywords: foreign-owned firms, related diversification, unrelated diversification, evolutionary economic geography, MNEs, international business studies

JEL-codes: F23, O18, O19, O33, P25, R11

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1. Introduction

Regional diversification is often depicted as a branching process in which new activities draw on and combine local activities (Frenken & Boschma, 2007). This is because search costs tend to rise rapidly as the gap widens between existing capabilities and new capabilities required to develop new activities, and because new activities unrelated to existing local activities tend to have a lower probability to survive (Nelson & Winter, 1982). A growing body of studies on industrial and technological diversification in regions has documented that related rather than unrelated diversification is indeed the rule (Boschma, 2017).

What is still underdeveloped though is a micro-foundation to this process of regional diversification, despite the fact that there is substantial evidence in the management literature that related diversification is a predominant feature within organizations (Palich et al., 2000). Klepper (2007) was one of the first papers to provide evidence of related diversification in regions at the micro-scale, by showing that spinoffs and diversifiers from related industries tend to give birth to new industries in regions. However, we still have little understanding of what types of firms induce related diversification, and what types of firms induce more unrelated diversification. More in general, there is little knowledge of how the capability bases of regions evolve over time, and what types of economic agents are responsible for more or less structural change. To our knowledge, Neffke et al. (2018) is the only study to date that has investigated systematically the link between firm dynamics and structural change at the regional scale. They found that the inflow of new plants from outside the region, and not so much local start-ups and incumbents, introduce more unrelated diversification in regions.

This finding of external agents driving structural change in regions makes it relevant to analyze the impact of inward FDI and especially the role of Multinational Enterprises

(MNEs). Studies have focused on the impacts of MNEs on economic development but most research is done at the national scale. Beugelsdijk et al. (2010) and Iammarino & McCann (2013) have advocated the integration of research in International Business and Economic Geography by investigating more systematically the geography of MNEs at the sub-national scale. In recent years, papers have been published on how MNEs influence the economies of host regions (Iammarino & McCann, 2013). However, to our knowledge, no paper has yet investigated the extent to which MNEs induce structural change in regions in terms of related or unrelated diversification, also in comparison with other types of firms: does novelty arise from local domestic firms, or is it introduced by actors from outside the region?

The objective of the paper is to investigate the extent to which FDI induce more related or unrelated diversification in 67 regions in Hungary between 2000 and 2009, a country that has been invaded by FDI after the fall of the Iron Curtain. This study is done in the context of a recent finding by Boschma & Capone (2016) that Eastern European countries, as compared to Western European countries, tend to diversify into new industries that are more closely related to their existing industries. We test whether MNEs (as compared to domestic firms) are responsible for more unrelated diversification in Hungarian regions, using novel methodology developed by Neffke et al. (2018) that measure structural change in terms of how unrelated new activities are to existing ones in regions. In doing so, this paper connects more tightly the literatures of International Business and Economic Geography around the theoretical framework of related and unrelated regional diversification. We find that in the short run (but to a lesser extent in the long run), foreign firms tend to show a higher deviation from the region's average capability match and thus, contribute to more structural change in regions, as compared to domestic firms, but this differs between different types of regions.

The paper is structured as follows. Section 2 develops the theoretical argument, discussing a micro-perspective on related and unrelated diversification in regions. Section 3 introduces the case of Hungary. Section 4 discusses the data and methodology, following closely the recent study of Neffke et al. (2018). Section 5 presents the findings. Section 6 concludes.

2. Regional diversification and MNEs

New activities do not start from scratch but are embedded in territorial capabilities, that is, they tend to spin out and draw on existing activities. This branching phenomenon (Frenken & Boschma, 2007) has been analysed by Hidalgo et al. (2007) at the country level, showing that countries build a comparative advantage in new export products related to existing export products in the country. Neffke et al. (2011) investigated diversification at the regional level and found a higher entry probability of an industry in a region when technologically related to pre-existing local industries. This finding on related industrial diversification in regions has been replicated in many follow-up studies (*e.g.* Colombelli et al., 2014; Essletzbichler, 2015; He et al., 2016), also when the focus is on technological diversification in regions (*e.g.* Kogler et al., 2013; Rigby, 2015; Boschma et al., 2015).

The above findings triggered research to explore conditions that make regions more likely to diversify into related or unrelated activities (*e.g.* Boschma & Capone, 2015, 2016; Petralia et al., 2017). What is still underdeveloped in this literature is a micro-foundation to this process of regional diversification. The management literature has shown overwhelming evidence that organizations tend to diversify in related activities (Farjoun, 1994; Palich et al., 2000). Klepper was one of the first to provide a micro-perspective to the regional branching literature. Studying a number of emerging industries (Klepper & Simons, 2000; Klepper, 2007), Klepper found that start-ups founded by entrepreneurs with pre-entry experience in related industries (*i.e.* spinoffs from related industries) and incumbents that diversified from related industries played a crucial role in the formation of new industries in a region.

However, we have little understanding of what types of firms induce related diversification, and what types of firms induce more unrelated diversification. More in general, there is little knowledge of how the capability base of regions evolves over time, and what types of agents are responsible for more radical and transformative change. Neffke et al. (2018) was one of the first studies that investigated systematically the relationship between firm dynamics and structural change in regions. This study showed that new plants from outside the region, rather than local start-ups and incumbents, tend to introduce more unrelated diversification in regions. In the short run, this applies especially to new plants set up by entrepreneurs, as compared to new plants set up by incumbents (subsidiaries). In the long run, Neffke et al. (2018) found that the difference between these types of new plants disappeared: it turned out

to be harder for stand-alone entrepreneur-owned plants to survive in regions that offered no related externalities, while subsidiaries could overcome the liability of newness in host regions that provided no supportive environment by drawing on firm-internal resources of the parent in the home region.

This makes it crucial to study the role of MNEs for regional diversification¹, an agent type not included in the study of Neffke et al. (2018) because of a lack of data. MNEs take up a large (and still increasing) part of the world economy (Iammarino & McCann, 2013). Scholars in International Business and Economic Geography have argued there is a scarcity of studies on the geography of MNEs at the sub-national scale (Beugelsdijk et al., 2010). In this context, Iammarino & McCann (2013) and Santangelo & Meyer (2017) have advocated the integration of evolutionary concepts like path dependency and related variety into the study of the geography of MNEs. The technology-gap literature (Fagerberg et al., 1994) has demonstrated that catching-up in countries is more likely to be successful when building on stronger capabilities and the smaller the distance from the technological frontier, but such studies at the sub-regional scale are scarce (Petrulia et al., 2017). Studies on the internationalization strategies of MNEs have shown that their R&D investments tend to concentrate in a few world leading centers of excellence where their own technological expertise is related (to benefit from local spillovers) but not identical (to avoid knowledge leakage) to the local technological capabilities (Cantwell & Santangelo, 2002; Cantwell & Iammarino, 2003). What is missing though is systematic evidence on the extent to which MNEs contribute to radical or incremental changes in the economic structure of regions.

MNEs may have a direct effect on structural change in their host economies, depending on the extent to which investments by MNEs concentrate in activities that are different from activities in which local firms are active (see *e.g.* Cantwell & Iammarino, 2000)². R&D investments by MNEs in technologies that are related but not identical to existing

¹ In International Business (IB) studies, regional diversification often gets a different meaning. While we focus on diversification of regions at the sub-national scale (as embodied in the successful emergence of an industry or technology that is new to the region), the IB literature often refers to regional diversification when an MNE pursues a diversification strategy within a region or across regions (Qian et al., 2013).

² Taking an Global Value Chain perspective focusing on shifts in tasks rather than industries, MNEs could also cause a shift from low- to high-tech tasks within the same industry in the host region (Damijan et al., 2013). This could be interpreted as structural change, as it requires different capabilities in the host region to make that shift. In this paper, we follow Neffke et al. (2018) and stick to industrial change, because this enables us to make a distinction between related diversification, defined as industrial change within the same set of capabilities, and unrelated diversification, defined as industrial change requiring a transformation of underlying capabilities.

technologies in the host region, with the purpose of tapping and exploiting local knowledge while avoiding leakage of their own knowledge, would reflect related diversification in the host region in our terminology. Instead, when MNEs invest in an activity that is new to the host region to exploit low local labour costs, this would reflect more unrelated diversification. Besides a direct effect, there may be also an indirect effect of MNEs on structural change in host regions which may be caused by productivity spillovers (like inducing local firms to introduce innovations through tougher competition and collaboration with MNEs) and market access spillovers (like making local firms exporting) (Iammarino & McCann, 2013). Studies have focused on the impact of MNEs on the upgrading and diversification of indigenous firms (Békés et al., 2009), like Javorcik et al. (2017), who found that FDI inflows stimulate the upgrading of indigenous capabilities of local domestic firms, making them move into complex products. What studies demonstrate is that new knowledge brought in by MNEs will not just spill over freely and benefit local firms. This spillover effect of FDI on indigenous firms in host regions depends on the absorptive capacity of local firms (Cantwell & Iammarino, 2003), their dynamic capabilities (Teece & Pisano, 1994), and the degree of fit between the characteristics of the MNE and the host region (Iammarino & McCann, 2013).

Despite this vast literature, to our knowledge, no paper has yet investigated the extent to which MNEs induce structural change in regions, and related or unrelated diversification in particular, in comparison with other types of firms. Based on the above, we expect that MNEs will induce more structural change than local firms. This is because foreign firms are more connected to international value chains, while local firms have more access to, are more familiar with, and more embedded in local capabilities (Pouder & St.John, 1996; Neffke et al., 2018). This is especially true in the longer run, as we expect MNEs to have higher survival rates than local firms when introducing a new activity more distantly related to existing activities in a region, as MNEs can build on firm-internal resources and capabilities in other regions to which they have access through their intra-corporate networks (Almeida, 1996; Cantwell & Piscitello, 2005; Alcácer & Chung, 2007; Neffke et al., 2018).

3. Data, sampling, variables and methods

This paper will test the extent to which foreign-owned firms in Hungary induce more structural change in regions than local domestic firms, both in the short and long run. Central and East European countries are an interesting case to investigate the impact of inward FDI on regional diversification. Boschma & Capone (2016) found that East European countries tend to diversify into new industries more closely related to existing industries than West European countries do. For theoretical reasons, as outlined earlier, we expect MNEs to induce more unrelated diversification in regions. In Central and Eastern Europe, inward FDI has been a major feature after the fall of the Iron Curtain. Broadly speaking, in the first stage of transition, foreign ownership caused little structural change in these former Communist countries, as investments came into established industries where previously state-owned companies were privatized. In the subsequent stage, inward FDI took place more in new and growing industries (like automotives). The more recent phase has been characterized by the predominance of foreign-owned firms investing in high-tech and export-oriented industries, in contrast to domestic firms (Hunya, 2000; Damijan et al., 2013).

Hungary is an outstanding country in Eastern Europe, as foreign-owned firms have become key actors from the second half of the 1990s onwards, determining export and employment levels of regional industries (Radosevic, 2002; Resmini, 2007; Kállay & Lengyel, 2008). Foreign-owned firms have brought new knowledge into Hungarian regions (Inzelt, 2008) and generated productivity spillovers to domestic firms (Halpern & Muraközy, 2007; Békés et al., 2009; Csáfordi et al., 2016). Moreover, research has shown that technological relatedness between co-located foreign and domestic firms has been crucial for regional growth (Elekes & Lengyel, 2016) and for firm dynamics in Hungary (Szakálné Kanó et al., 2016). This makes Hungary a highly relevant case to test the extent to which foreign-owned firms induce more structural change in regions than domestic firms, both in the short and long run.

This research relies on a firm-level panel micro-database made available by the Hungarian Central Statistical Office, containing various balance sheet data on companies conducting business in Hungary and using double-entry bookkeeping. These concern tax declaration data that firms in Hungary have to submit to the National Tax Office. Data includes the location of the company seat at the municipality level, the number of employees, the NACE classification of the main activity of the company at the 4-digit level, and several balance sheet variables

like net revenue and ownership structure of the total equity capital. We limit our investigation of structural change to the 10-year-period between 2000 and 2009, due to data availability. The additional years of 1999 and 2010 were used to determine agent type.

We imposed some restrictions on the data to arrive at the final sample of companies. First, we focus only on manufacturing firms (industries 15 to 37 in NACE Rev. 2. coding). This is necessary because company seat data is at our disposal, which is more likely to represent the actual place of economic activity in the case of manufacturing. 90% of these firms have only one plant, and two third of the employees of the remaining firms work at the company seat (Békés & Harasztosi, 2013). Second, a major portion of inward FDI in Hungarian is targeting manufacturing industries (Barta et al., 2008). Additionally, MNEs use Hungarian regions mostly as assembly platforms of semi-standardized, labour-intensive goods as part of their global value chains (Nölke & Vliegenthart, 2009). This is especially the case in the manufacturing integration zone of the North-West (Lux, 2017a, 2017b).

So as to increase the reliability of the data, we limit our analysis to those firms that had no less than two employees between 2000 and 2009. Naturally, increasing this threshold would further improve data reliability. However, doing so would also introduce bias towards incumbent firms as new entrants tend to be smaller in size. Additionally, foreign firms on average are larger in size compared to domestic ones. Consequently, increasing the threshold would introduce bias in the firm sample towards foreign ownership.

In order to classify firms into agent types, we use two dimensions yielding a total of eight agent types. The first dimension concerns firm life-cycle, meaning we divide firms into entrants, growing incumbents, declining incumbents, and exits. For analytical purposes we consider a firm an *entrant* in year t if it is present that year, but not in the previous one. We classify a firm incumbent in year t if it was present in the previous year as well as in the next year. Finally, we consider a firm to *exit* in year t if it is present in the data that year, but not in the proceeding one. To distinguish between growing and declining incumbents, we compare the employment of those firms that are classified incumbents in year t to their employment value in $t - 1$. Incumbents that managed to increase their employment are deemed *growing incumbents*, while those firms that decreased in size are considered *declining incumbents*.

To determine these firm attributes, we also used the panel data for 1999 and 2010, but left these years out of the final sample, as otherwise all firms would have been considered entrants in 1999, while all firms would have exited in 2010. To do this classification, we consider only those firms that are present in the panel without gaps, and are present for more than one year. The latter step is necessary to avoid classifying a firm as entry and exit in the same year.

The second dimension for classifying agents is ownership. We define a firm *foreign-owned* if more than 50% of its total equity capital belongs to a foreign owner. This percent is more conservative than the OECD (2008) benchmark definition on FDI that uses 10% because majority ownership may be a prerequisite for the foreign owner to induce changes in the firm. Additionally, the ownership distribution of Hungarian firms is extremely polarized, *i.e.* the share of foreign ownership in most cases is either above 90% or below 5% (Appendix 1).

We use micro-regions as the spatial unit of analysis, because these 175 territories represent nodal regions of towns in Hungary and correspond to the LAU1 administrative level of the EU spatial planning system. In the final step of the sample selection process, we restrict the analysis to those regions that had at least 5 domestic and foreign firms throughout the period of 2000 to 2009. As a consequence, 67 micro-regions constitute our final sample of regions, representing larger settlements with at least some manufacturing activities. The pool of firms in our analysis represents on average 37% of all manufacturing firms in the data, and these firms employ on average 74% of all employees in manufacturing (Appendix 2). On average, 87% of firms in the sample are domestic, however these firms represent on average 52% of employees. In addition to that, the share of domestic firms slightly increased during the 2000 to 2009 period, while their share of total employment slightly decreased (Appendix 3).

For our investigation of structural change, we follow the novel approach introduced by Neffke et al. (2018). First, we measure the degree of skill relatedness between industries (Neffke & Henning 2013). We use a matched employer-employee dataset provided by the Hungarian Academy of Sciences, making it possible to track labour flows between industries for the years 2003 and 2010. As shown in Equation 1, the skill relatedness measure (SR_{ij}) shows how above expected is the labour flow (F_{ij}) between a pair of (4-digit NACE) industries ($i \neq j = 1, \dots, N$), compared to all labour flows from (F_i) and to (F_j) these industries.

$$SR_{ij} = \frac{F_{ij}}{F_i F_j} F_{..} \quad (1)$$

The normalized form of skill relatedness is used, meaning that it ranges from -1 to 1 , with a higher value meaning stronger skill relatedness between industries. For analytical purposes, we subsequently consider a pair of industries related if their skill relatedness is higher than 0 . The manufacturing focus of the analysis makes it necessary that we exclude those ties between industries that involve non-manufacturing industries. Our skill relatedness network tends to be time-robust on our timeframe, so we use the skill relatedness network of 2003 to 2010 as the underlying map of relatedness between industries for the period 2000 to 2009.

Next, with the help of the skill relatedness measure, we calculate the amount of related employment ($E_{i,r,t}^{rel}$) in a region ($r = 1, \dots, R$) in a year ($t = 1, \dots, T$) for each 4-digit NACE industry in the sample. We dichotomize the skill relatedness measure with an indicator function ($I(.)$) so that it gives a value of 1 if skill relatedness is higher than 0 , and 0 otherwise. The measure allows for similarity of industries, meaning that related employment for each industry equals the sum of employment in related industries and the industry itself (equation 2).

$$E_{i,r,t}^{rel} = \sum_j E_{j,r,t} I(SR_{ij} > 0) \quad (2)$$

The third step is to quantify how each industry matches the industrial structure of a region in a year. To do so, a modified location quotient is used that measures how overrepresented are related industries ($E_{i,r,t}^{rel}$) in a regional industry portfolio ($E_{r,t}$), compared to the share of related industries ($E_{i,t}^{rel}$) in the overall country level portfolio (E_t) (equation 3).

$$LQ_{i,r,t}^{rel} = \frac{E_{i,r,t}^{rel}/E_{r,t}}{E_{i,t}^{rel}/E_t} \quad (3)$$

To reduce the skewness of the distribution of the location quotient, it is normalized to produce the *capability match* ($M_{i,r,t}$) variable, which ranges from -1 to 1 . A match value above 0

indicates an overrepresentation of related industries in a region in a year. Industries with a high match value are more related to the regional industrial portfolio of that year (equation 4).

$$M_{i,r,t} = \frac{LQ_{i,r,t}^{rel} - 1}{LQ_{i,r,t}^{rel} + 1} \quad (4)$$

Industries in a regional portfolio of a given year have different match values, but industries in some regions are more related *on average* than in others. To capture this *coherence* ($C_{r,t}$), we calculate the weighted average capability match within each region in each year, where the weights are the share of employment of each industry ($E_{i,r,t}$) from the regional portfolio ($E_{r,t}$) that year. As shown in Equation 5, a higher value of coherence would indicate that a region has more industries that are more related to the regional portfolio.

$$C_{r,t} = \sum_{i=1}^N \frac{E_{i,r,t}}{E_{r,t}} M_{i,r,t} \quad (5)$$

Now each agent ($a = 1, \dots, A$) in a regional economy can be characterized by the deviation of its industry's capability match from the region average ($M_{i,r,t} - C_{r,t}$). A positive value of such deviation implies that the agent's industry is above averagely related to the regional portfolio. We aim to find out whether agents of the same agent type tend to deviate from the region average capability match over time. To describe the distribution of this deviation within an agent type, in the final step we calculate the structural change induced by an agent type³ ($S_{A,r,t,t+n}$) over a period of time (between t and $t + n$, where $1 \leq n \leq 10$) as the weighted average level of deviation of the base year (t). Here the weights are calculated as the share of employment created or destroyed by an agent of an agent type ($\Delta E_{a,i,r,t,t+n}$) in the total employment change ($\Delta E_{A,r,t,t+n}$) induced by the agent type over a period of time ($t, t + n$). As shown in equation 6, the employment effect of entrants and exits is measured as their employment value in the year of entry or exit, while the employment effect of growing and declining incumbents is the change in their employment values over the period concerned.

³ Note that structural change was indicated by A in Neffke et al. (2018).

$$S_{A,r,t,t+n} = \sum_{a=1}^A \frac{\Delta E_{a,i,r,t,t+n}}{\Delta E_{A,r,t,t+n}} (M_{i,r,t} - C_{r,t}) \quad (6)$$

The values of the structural change variable range from -2 to 2 , and values above 0 indicate above average capability match between an agent type and the regional industrial portfolio. The regional capability base will be reinforced over time if an agent type tends to create employment in industries with above average match score, *i.e.* it shows a positive score on the structural change variable. Below average match score would instead indicate the weakening of the same regional capability base. Agent types that destroy employment have an influence in the opposite direction. This is summarized in Table 1. The aim is to determine *which agents* change the economy of a region. Following Neffke et al. (2018), we estimate the above unconditional mean structural changes with a weighted regression. Using the base year of 2000, we obtain short-term change using employment weights between 2000 and 2001, and long-term structural change values using weights calculated over the 2000-2009 period.

Table 1. Summary of the relationship between agent types and regional capability bases.

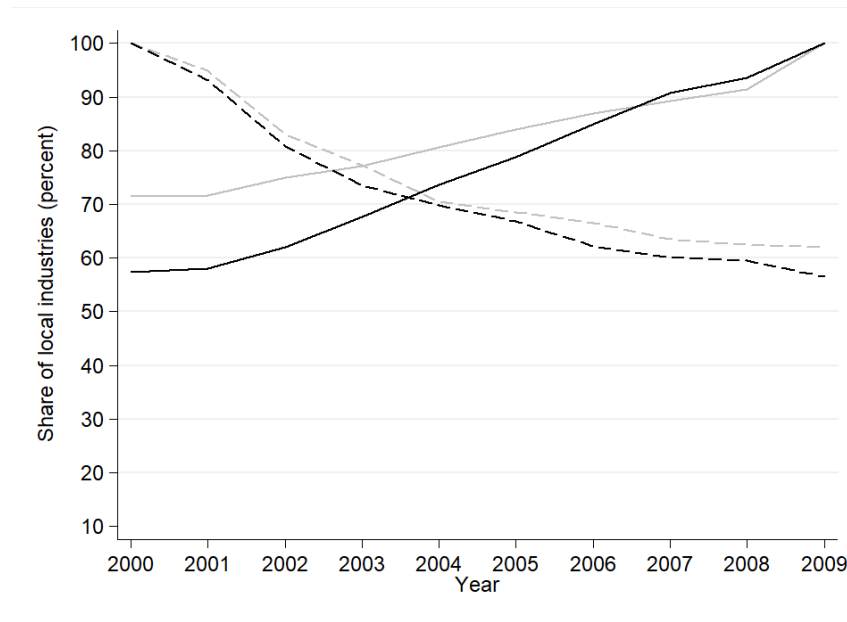
Agents of an agent type...	with below average capability match on average ($S_{A,r,t,t+n} < 0$)	with above average capability match on average ($S_{A,r,t,t+n} > 0$)
creating employment. ($\Delta E_{a,i,r,t,t+n} > 0$)	Agents <i>weaken</i> the regional capability base.	Agents <i>reinforce</i> the regional capability base.
destroying employment. ($\Delta E_{a,i,r,t,t+n} < 0$)	Agents <i>reinforce</i> the regional capability base.	Agents <i>weaken</i> the regional capability base.

4. Structural change in Hungarian regions

Figure 1 shows there are substantial changes in the industrial composition of regions during the period 2000-2009. Only 60% of the 4-digit industry-region combinations present (*i.e.* with concentrated employment, $LQ > 1$) in 2000 were still present in 2009, while 30-40% of the industry-region combinations present in 2009 were not present in 2000. When considering employment in foreign and domestic firms separately, it is revealed that a lower percentage industry-region combinations of 2009 were already present (*i.e.* with concentrated

employment considering only foreign firms, $LQ > 1$) in 2000 in the case of foreign firms, compared to the industry-region combinations considering employment only in domestic firms. The differences between the ownership groups are marginal when it comes to industries phasing out from the industrial composition of regions. This finding already suggests that foreign firms are more active in exploring new (to-the-region) economic activities compared to domestic firms.

Figure 1. Turnover of regional industries 2000-2009

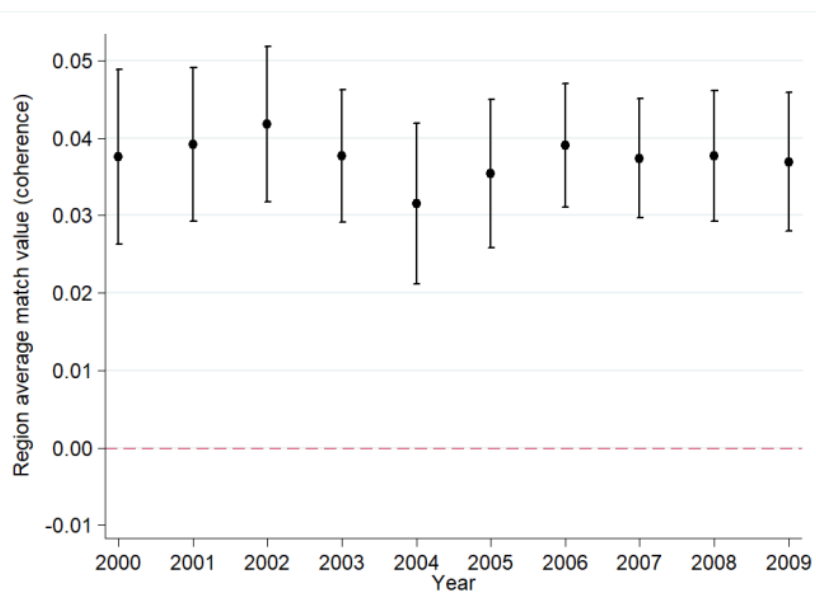


Notes: Dashed lines indicate the share of industry-region combinations with concentrated employment ($LQ > 1$) in 2000 out of the industry-region combinations with concentrated employment ($LQ > 1$) in year t ; solid lines indicate the share of industry-region combinations with concentrated employment ($LQ > 1$) in 2009 out of the industry-region combinations with concentrated employment ($LQ > 1$) already in year t . Black lines indicate shares calculated with employment concentration considering only the employment in foreign firms; grey lines indicate shares calculated with employment concentration considering only the employment of domestic firms.

However, the mere appearance of new industries may or may not change the underlying capability base of regions. Therefore, we have also looked at the average coherence of regions over time, which would be indicative of the size of the underlying regional capability base over which industrial turnover occurs. Thus, for each year we calculated the average coherence of the 67 microregions in the sample, yielding an estimate of average skill relatedness of industries within regions (*i.e.* coherence), averaged across regions. As shown in Figure 2, we find a positive and relatively stable level of average coherence across regions. This means that regions house a concentration of related industries for economic agents.

Moreover, the average concentration of skill related industries in regions shows stability, in spite of the considerable turnover of industries shown in Figure 1.

Figure 2. Average levels of regional coherence 2000-2009



Notes: The red dashed line indicates no average over- or underrepresentation of related industries in year t . Values above this line indicate on average a concentration of related employment in regions

Now we turn to structural change by agent type, *i.e.* the change in the composition of the aforementioned regional bundle of capabilities, starting with short-term (1-year) change. As shown in Figure 3, new firms and growing incumbents tend to weaken the regional capability base by creating employment in industries that are below averagely skill-related to the region. While declining incumbents as well as exits appear to be below averagely related to the region as well, this indicates that they reinforce the capability base, because they destroy employment in more unrelated activities. This pattern of firm population dynamics underpins the observation about the stability of the regional capability base made earlier, as new and successful economic actors balance out, on average, declining and exiting firms.

Looking at the firm population more closely, we find that new entrants seem to be more related to the region's capability base than growing incumbents. This finding is different from what Neffke et al. (2018) found. Second, new entrants are more related on average to the capability base of the region compared to exiting firms. This is in line with Neffke et al (2018) and our understanding of the evolution of regions following a path dependent process in which activities more related to the region are more likely to enter, while those that are less

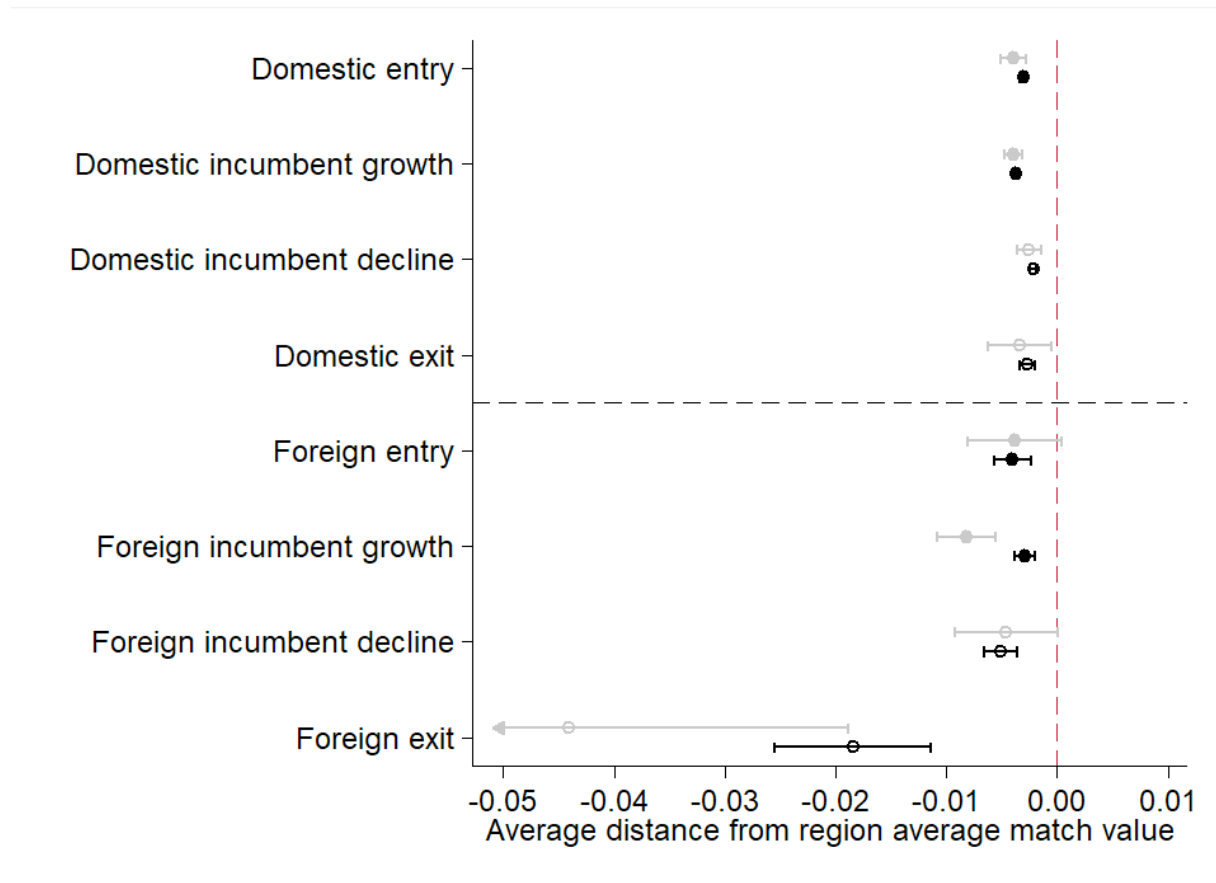
related are more prone to exit (Neffke et al., 2011). In sum, this entry-exit dynamic tends to reinforce the capability base of regions, as the employment created is more closely related to regional activities than the employment destroyed.

Overall, the findings for the short term effects indicate that entries are closest to the regional capability base, though still bringing some novelty to the region, as indicated by their positive value on structural change. However, incumbents bring about more structural change in regions, widening the regional capability base: growing firms are more active in activities that are more unrelated to existing activities in the region, while declining incumbents tend to be more related to the capability base of the region than growing incumbents. The opposite is true for exiting incumbents: firms whose activities drifted far away from the core of the regional capability base tend to exit the region, reinforcing the regional capability base.

The findings on short-term structural change for the dimension of domestic versus foreign ownership are presented in Figure 3. We found that foreign firms tend to show a higher deviation from the region average capability match than domestic firms. When assessing their impact on the regional capability base, one has to keep in mind the relatively low number of foreign firms (15%) in our dataset although their share in employment (47%) is considerable (see Appendix 3). In line with our expectations, this finding suggests that foreign firms are shaping regional capability bases to a higher degree than domestic firms. In particular, growing foreign incumbents happen to occur in industries that are more unrelated to existing activities in the region than domestic firms. The fact that growing foreign firms (and to a lesser extent the entry of foreign firms) can deviate more from the regional capability base suggests that MNEs may be able to compensate for the lack of access to regional capabilities through their intra-corporate networks, as explained in the theoretical section. The slight advantage of foreign firms compared to domestic firms in one-year survival rates, using Kaplan-Meier estimates⁴, as shown in Figure 4, seems to support this claim.

⁴ The Kaplan-Meier survival functions were plotted based on those foreign and domestic firms that were new entrants in regions between 2000 and 2009. New firms are at risk of exit, and are more likely to be active in the shorter run than in the long-run.

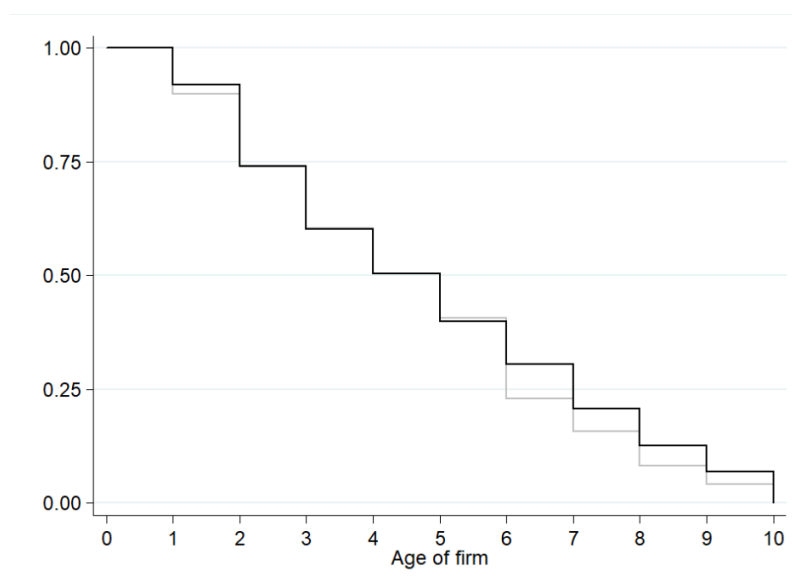
Figure 3. Short and long-term structural change in regions by agent type



Notes: The red dashed line indicates the average distance of agent types from the regional average match value. Values to the right of this line indicate more related (*i.e.* above average) diversification, while values to the left indicate more unrelated (*i.e.* below average) diversification. Error bars indicate 95% confidence intervals. The base year is 2000. Grey markers indicate 1-year change, black markers indicate 10-year change.

Another finding is that foreign exits tend to deviate most from the regional capability base. Foreign firms active in industries more unrelated to local activities are more likely to exit than domestic firms, which is a surprising finding, as one would expect foreign firms that are disconnected from regional capabilities, to be less harmed because of their access to firm-internal resources. Having said that, caution is warranted when interpreting the foreign exit match-distribution, because it is by far the most volatile among the agent types and through different time horizons (see Appendix 4H). This volatility is most likely caused by the relatively small number of exits in the sample, as well as the "chunkiness" of employment, meaning that an exit event affects the number of employees at once. In the base year of 2000, 70 instances of foreign exit occurred, representing 0.71% of the firm sample in that year, averaging 100 employees each (see Appendix 3).

Figure 4. Kaplan-Meier estimates of new firm survival by ownership.



Notes: Black lines indicate survival estimates of foreign new firms; grey lines indicate domestic new firms.

The previous findings on structural change induced by different agent types in the short-run (1 year) are for the most part persistent over time. When looking at change in the long-run (10 years) (Appendix 4), there is a slight shift towards more related activities when moving from the short to long term (Figure 3). This is most pronounced when looking at growing foreign firms (Appendix 4F) and foreign exits. This suggests that persistent success requires a stronger fit to the regional capability base even for MNEs that have access to firm-internal resources to compensate for lacking local capabilities. This may partly be attributed to stronger relationships between MNEs and local firms established over time (Wintjens, 2001). It is interesting to see that the average match of growing foreign firms gets close to the average match of growing domestic firms over time (Appendix 4B and 4F), indicating that in the longer run, growing firms rely on the regional capability base to a considerable degree.

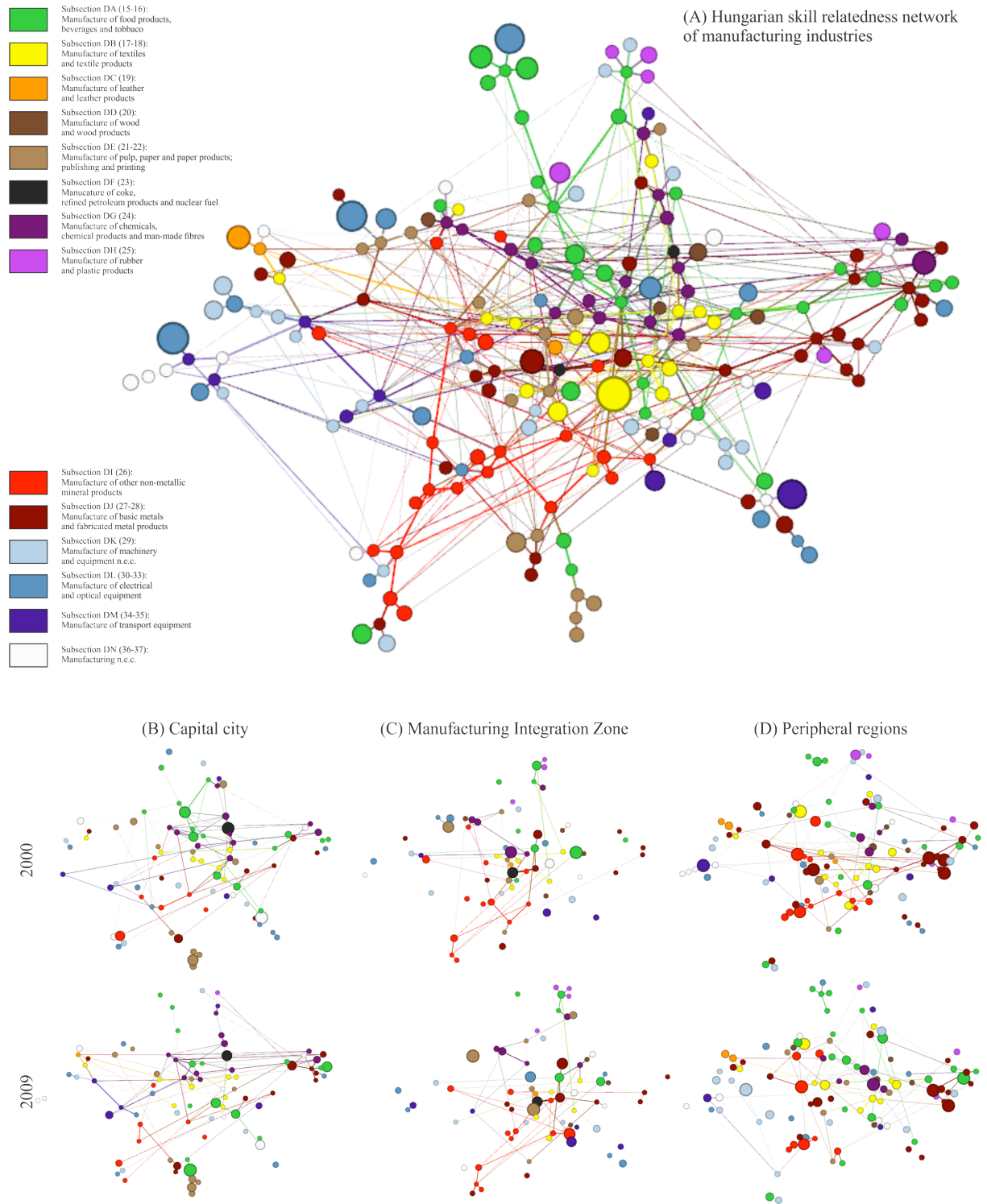
So far, we presented the pattern of structural change in all Hungarian regions. However, the diversification process may differ between regions. Xiao et al. (2018) found that the effect of relatedness on diversification varies across regions in Europe: it decreased as the innovation capacity of a region increased, showing the weakest effect in core regions. Moreover, Hungarian regions differ with respect to industrial structure and FDI intensity. Lengyel & Leydesdorff (2015) demonstrated that foreign firms contribute to local synergies only in some developed regions in the north-western part of the Hungary. Following their territorial distinction and those of others focusing on re-industrialization (Vas et al., 2015; Lengyel et

al., 2016; Lux, 2017a, 2017b), we check whether the diversification dynamics induced by foreign firms is different in three region types. The first is the *capital city* (Budapest) that is a frequent host for foreign firms, and which is subject to a general outflow of manufacturing industries. The second is the *Manufacturing Integration Zone* in the relatively developed North-Western part of the country that gained access to international value chains through foreign actors. The third is a group of *peripheral regions* in the South and East that are relatively underdeveloped and characterized mostly by low-value added textile and food industries, and where the main objective of foreign firms is access to low labour costs and consumer markets.

Figure 5 gives a visual representation of the skill relatedness network between manufacturing industries for the whole of Hungary, as well as the subgraphs of the three region groups for the year 2000 and 2009. While many of the industries that are classified in the same NACE 2-digit category tend to be clustered together, the skill relatedness approach also reveals separately classified industries to be related in terms of labour input. Naturally, the region group-level networks are more sparse with a visibly high concentration of the manufacture of textiles and textile products (Subsection DB), and resource-driven activities like the manufacture of other non-metallic mineral products (Subsection DI) and the manufacture of basic metals and fabricated metal products (Subsection DJ).

A high share of FDI characterises the surrounding regions of the *capital city*, and also the North-West of the country (Appendix 5A). Interestingly, the regional coherence values do not correlate with the share of inward FDI in the region, as the correlation coefficient is -0.03 over the period 2000 to 2009. This suggests that the strong presence of foreign firms is not necessarily accompanied by a regional capability base that contains unrelated elements.

Figure 5. Industry spaces for the whole of Hungary and for the 3 region groups

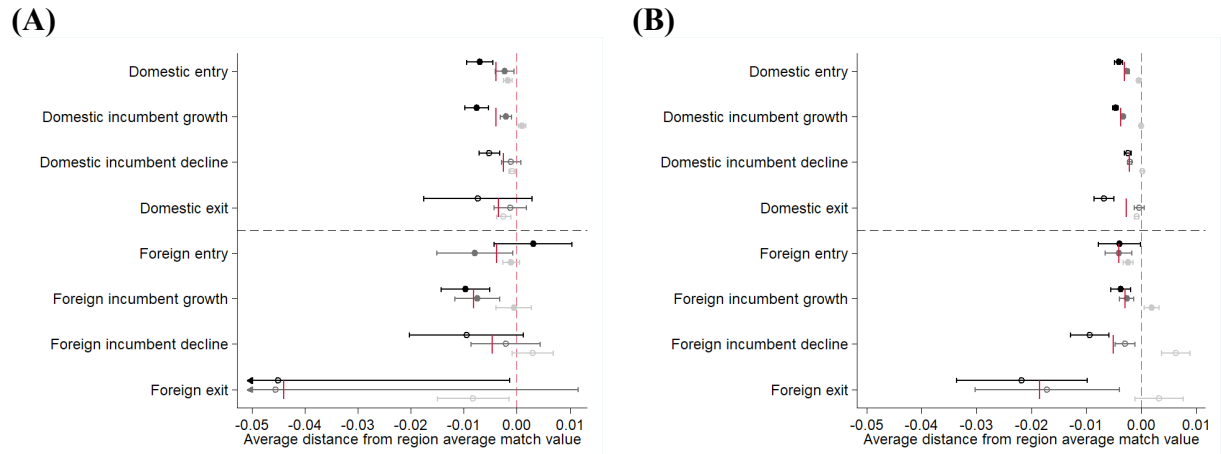


Notes: (A) The network representation was constructed by superimposing the strongest 1.5% of edges on the maximum spanning tree of the skill relatedness network. ForceAtlas2 layout in Gephi software was used as layout. After obtaining the network layout, additional ties up to the strongest 5% of all edges were added to the graph. Node size is proportional to the number of employees in each industry. (B-D) Node size represents employment location quotient; only those industries are represented that have $LQ > 1$.

Figure 6 shows the degree of structural change induced by each agent types in the 3 region groups. The behaviour of different agent types in the *Manufacturing Integration Zone* is most similar to the patterns observed for the whole of Hungary. Both growing and declining firms tend to be more unrelated to the regional portfolio activities. This sets this region group apart from the rest because foreign incumbents are active in more unrelated activities than in the other 2 region groups. Interestingly, foreign entry on average does not show a deviation from region average match value in the short run, however this deviation gradually becomes larger over time (Appendix 6E). This suggests that foreign entrants in these regions initially match the capability base well. However, as time passes by, entry activity of these firms introduce more and more unrelated activities to the region. Interestingly, domestic entrants are also exploring more unrelated activities, staying further from the region average match than in any other region group, but less so than foreign firms. The pattern that emerges from the structural change values is that there is a large amount of exploration going on by both domestic and foreign agents in the *Manufacturing Integration Zone*, as most new entries, as well as growing incumbents, are associated with more unrelated activities. On the downside, declining and exiting firms in this region group also tend to be more unrelated to the capability base of 2000 compared to the other two region groups, especially in the case of foreign economic agents. The *Manufacturing Integration Zone* seems to be a harsher environment for new firm survival as well, compared to the peripheral regions, especially for long-term survival, as shown in Figure 7a and 7b.

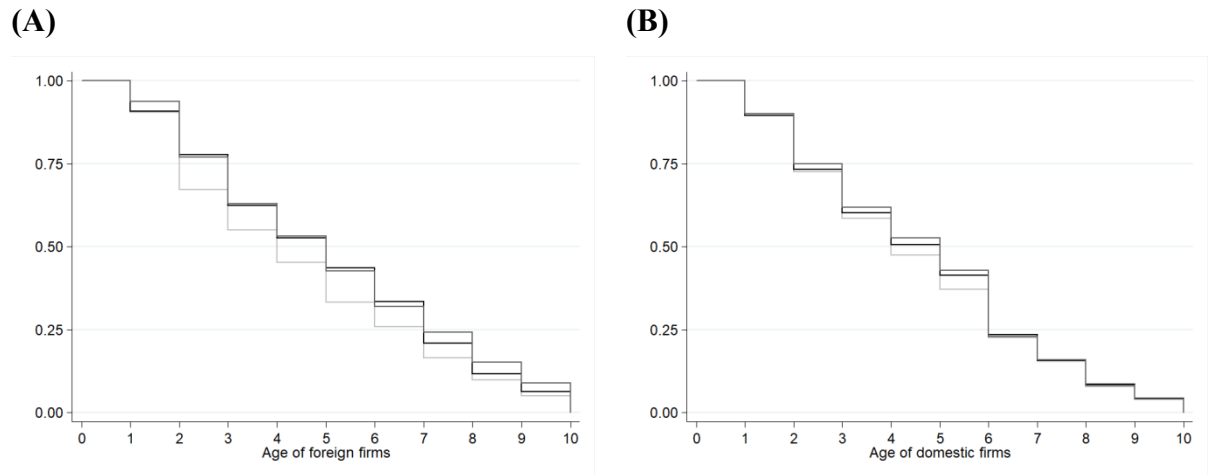
In *peripheral regions*, most agent type behaviour tends to mimic the one in the *Manufacturing Integration Zone*, but at a much smaller scale. As Figure 6 shows, both domestic and foreign agents show smaller deviations from the region's average. New or growing firms introduce less structural change, and foreign firms show a higher capacity for inducing structural change than domestic firms.

Figure 6. Structural change by agent type in the 3 region groups



Notes: **(A)** Short-term (1-year) structural change. **(B)** Long-term (10-year) structural change. The red dashed line indicates the average distance of agent types from the region average match value. Values to the right of this line indicate more related (*i.e.* above average) diversification, while values to the left indicate more unrelated (*i.e.* below average) diversification. Error bars indicate 95% confidence intervals. The base year is 2000. Black error bars depict the *Manufacturing Integration Zone*, dark grey error bars indicate the *peripheral regions*, light grey bars signify the *capital city*. Red solid vertical lines indicate the agent type-average structural change.

Figure 7. Kaplan-Meier estimates of new firm survival by region group.



Notes: **(A)** Foreign firms **(B)** Domestic firms. Black lines indicate survival estimates of new firms in the *Manufacturing Integration Zone*; dark grey lines represent survival in *peripheral regions*; light grey lines signify survival in the *capital region*.

The *Capital region* is very different from the *Manufacturing Integration Zone*. As Figure 6 shows, domestic firms barely exhibit any tendency to deviate from the region average match score. Foreign entrants tend to well match the capability base at an average level in the short run, and gradually become slightly more unrelated over time (Appendix 6E). This indicates

that foreign entries slightly weaken the capability base in the *capital region*. From a location choice perspective, foreign firms may seek out locations that are more successful at signalling their available resources, and the *capital region* has most capacity to do so. Domestic firms on the other hand are well endowed with locally available knowledge, matching the capability base more tightly over time. Foreign exit on the short run happens at a larger distance from the regional capability base, however this deviation is the smallest among the region groups. Foreign incumbents match the capability base averagely in the short run. Interestingly, foreign incumbents and exits shift to the related side in the longer run, meaning that foreign growing incumbents reinforce the regional capability base, while foreign declining incumbents and foreign exits weaken the manufacturing capabilities in the capital over time. As shown in Figure 7a, the long term survival rates of foreign entries seem to support this, as these have slightly lower chances of survival in the *capital region* compared to other regions. Domestic entries exhibit a similar pattern, although less pronounced (Figure 7b).

Overall, our findings show striking differences between regions. Almost any agent type in the *Manufacturing Integration Zone* is more unrelated to the region capability base, as compared to the *Capital region* of Budapest. Entry induces structural change in regions. The effect of domestic entry differs across regions and these differences remain stable over time. Interestingly, the effect of foreign entry differs across regions in the short run (inducing more related diversification in the *Capital region*, and more unrelated diversification in the *Manufacturing Integration Zone*) but drives more unrelated diversification in all types of regions in the long run. Growing incumbents (especially foreign ones) weaken the capability base of regions, except in *peripheral regions*. Declining incumbents strengthen the capability base of regions, especially in the *Capital region*, but not so in *peripheral regions*. Foreign exits tend to strengthen region capability base, but not in *peripheral regions*.

5. Conclusions

The literature on regional diversification has demonstrated that local capabilities are a strong driving force behind regional diversification, but that regions also evolve in more unrelated directions now and then (Boschma, 2017). However, there is still little understanding of what types of firms, including external agents like MNEs, induce related and unrelated diversification in regions. We show MNEs are key agents of structural change. Following a novel approach introduced by Neffke et al. (2018), our study of 67 Hungarian regions show

that foreign firms induce more structural change in regions than domestic firms do. The fact that growing foreign firms (and to a lesser extent the entry of foreign firms) can deviate more from the regional capability base suggests that MNEs may be able to compensate for the lack of access to regional capabilities through their intra-corporate networks. We also observed a slight shift towards more related activities in the long run, especially for growing foreign firms and foreign exits, suggesting that a stronger fit to the regional capability base is important even for MNEs despite access to firm-internal resources. Finally, we found significant differences across regions: agents in the *Manufacturing Integration Zone* tend to be more unrelated to the region capability base than in the *Capital region*. What makes the Budapest region unique is that growing and declining foreign firms as well as foreign exits are more related on average to the region capability base in the long run. Interestingly, in the short term, foreign entry induces related diversification in the *Capital region* and more unrelated diversification in *Manufacturing Integration Zone*, but it drives more unrelated diversification in all regions in the long run. Growing incumbents weaken the region capability base, while declining incumbents and foreign exits strengthen it, but not so in *peripheral regions*.

This paper takes a first step to integrate research on regional diversification with the vast literature on MNEs. However, as any other paper, our study has a number of limitations which should be taken up in future research.

First, with our data at hand, we could not make a distinction between different internationalization strategies of MNEs which might be highly relevant for the type of diversification MNEs might cause directly or indirectly in regions (Santangelo & Meyer, 2017). Our analysis focused on the direct effects of MNEs on regional diversification, and not on the indirect effects of MNEs on local indigenous firms. Therefore, there is a need to conduct a systematic analysis on both the direct and indirect effects of MNEs on structural change in regions. In this respect, one could hypothesize that when the direct effect of MNEs cause unrelated diversification (investing, for instance, in activities completely new to the host region to benefit from low costs to produce standardized goods), we expect the indirect spillover effects to local indigenous firms to be low, due to the large gap between the new and existing local activities. Instead, when the direct effect of MNEs would induce related diversification (through for instance, R&D investments in activities related to local activities

for the purpose of exploiting local learning opportunities), one would expect the indirect effects to be larger, because spillovers are enhanced across related activities.

Second, there is a need to integrate our approach on industrial diversification in regions with the Global Value Chain approach that focuses more on stages of production within industries (Los et al., 2015). This is because the impact of MNEs on regional diversification may be reflected in a move into new industries (as shown in our study) but also into new production stages (e.g. from low to high complexity) within the same industry. The latter would mean the region would diversify into new (and more sophisticated) stages of the Global Value Chain, which requires also very different capabilities, and, therefore, would be completely in line with the definition of structural change employed in this study. Another limitation of our study is that it was limited to manufacturing industries due to data restrictions. Future research should focus on the impact of MNEs on diversification into service industries which nowadays take up a considerable part of regional economies (Ascani & Iammarino, 2017).

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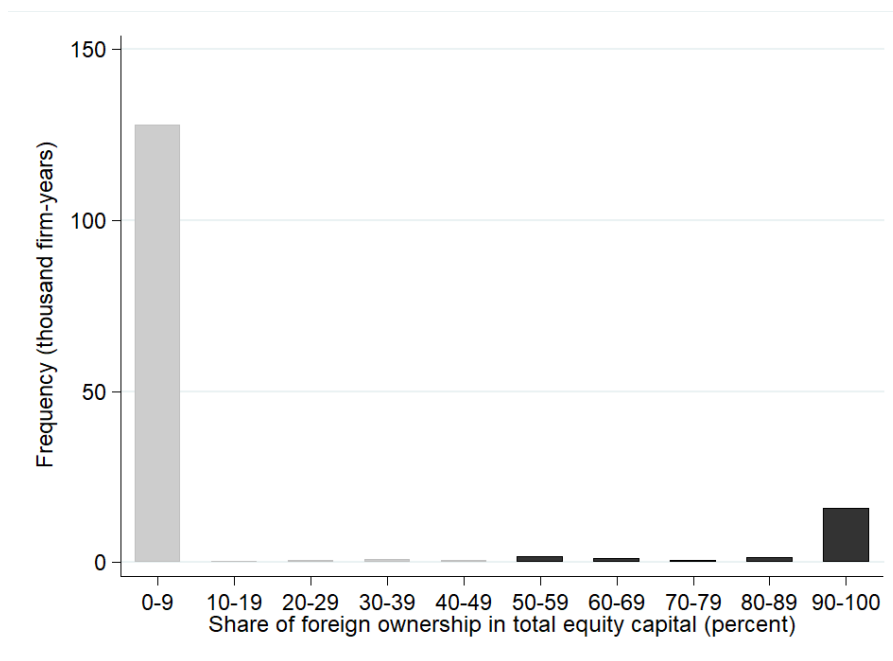
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7. Appendix

Appendix 1. Share of foreign ownership in total equity capital for firm-year combinations in the sample.



Notes: Grey bars indicate firm-year combinations classified as domestic-owned, black bars indicate foreign ownership.

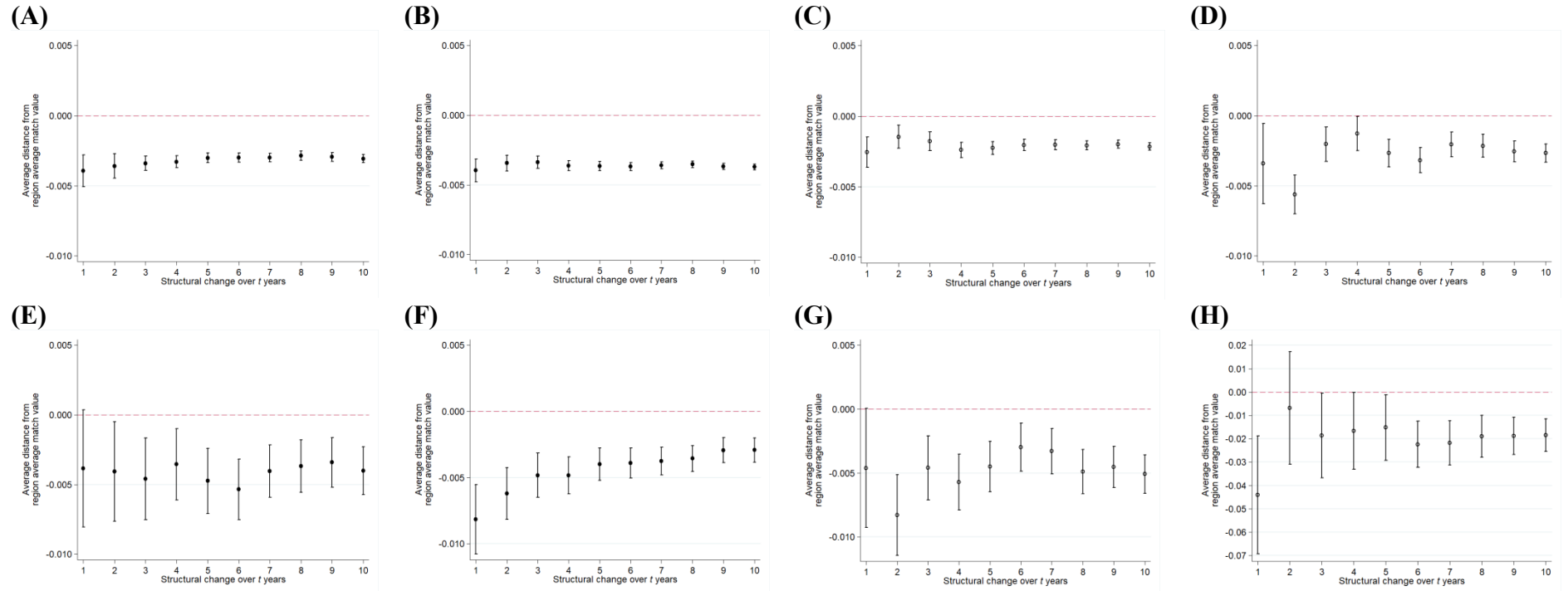
Appendix 2. Descriptives on sample selection.

Year	Population		Manufacturing only		At least two employees		No gaps		No 1-year firms		No regions with too few firms	
	No.	Emp.	No.	Emp.	No.	Emp.	No.	Emp.	No.	Emp.	No.	Emp.
2000	148854	2013680	22083	782694	12465	727899	12217	713261	12093	711281	9886	586805
2001	181123	2045079	24676	780267	12933	717414	12675	704533	12490	702454	10197	580290
2002	202675	2037783	26676	760688	13212	698746	13023	688766	12752	685289	10355	566271
2003	223977	2067481	28257	744354	13376	682114	13201	671064	12995	667702	10560	552098
2004	310692	2199668	37440	734806	15599	665660	15402	658296	14915	652557	12087	537598
2005	282651	2197393	34594	713055	15373	643470	15186	636797	15006	631930	12136	523674
2006	283933	2262240	33843	696282	15274	624238	15105	618487	14931	615359	12064	508291
2007	296099	2231626	34031	687916	15236	620193	15053	613993	14923	612110	12036	505989
2008	335410	2216955	36280	671563	15263	612072	15066	606049	14898	604780	12022	499962
2009	342822	2082788	35963	603946	15386	548788	15100	541910	14788	526123	11932	435053

Appendix 3. Descriptives on agent types in the sample.

Year	All		Entry		Incumbent growth		Incumbent decline		Exit	
	No.	Emp.	No.	Emp.	No.	Emp.	No.	Emp.	No.	Emp.
Domestic										
2000	8361	311860	826	15425	3123	135023	3987	148261	425	13151
2001	8661	304854	723	9754	2603	134642	4242	141243	1093	19215
2002	8838	302385	1268	25581	2540	102757	4332	153932	698	20115
2003	9090	299560	921	16076	2721	105078	4699	155523	749	22883
2004	10625	298985	2292	18522	2732	119615	4871	142353	730	18495
2005	10768	285338	810	11228	3027	86156	6188	160080	743	27874
2006	10711	270575	681	10373	3245	103309	6068	137020	717	19873
2007	10679	255763	684	9710	3033	114802	6379	115816	583	15435
2008	10623	243292	559	8244	2763	86157	6271	118874	1030	30017
2009	10580	207387	987	9285	1783	55818	6515	118781	1295	23503
Foreign										
2000	1525	274945	120	14072	789	163240	546	90717	70	6916
2001	1536	275436	82	3979	690	150570	629	112089	135	8798
2002	1517	263886	118	4018	541	112930	747	136609	111	10329
2003	1470	252538	93	4545	565	130717	706	102989	106	14287
2004	1462	238613	90	3058	583	122729	688	105609	101	7217
2005	1368	238336	70	4455	528	115617	676	110152	94	8112
2006	1353	237716	84	4069	610	144299	598	83919	61	5429
2007	1357	250226	66	3617	682	169689	562	73281	47	3639
2008	1399	256670	57	2527	586	149258	641	98125	115	6760
2009	1352	227666	68	2696	303	45617	845	166793	136	12560

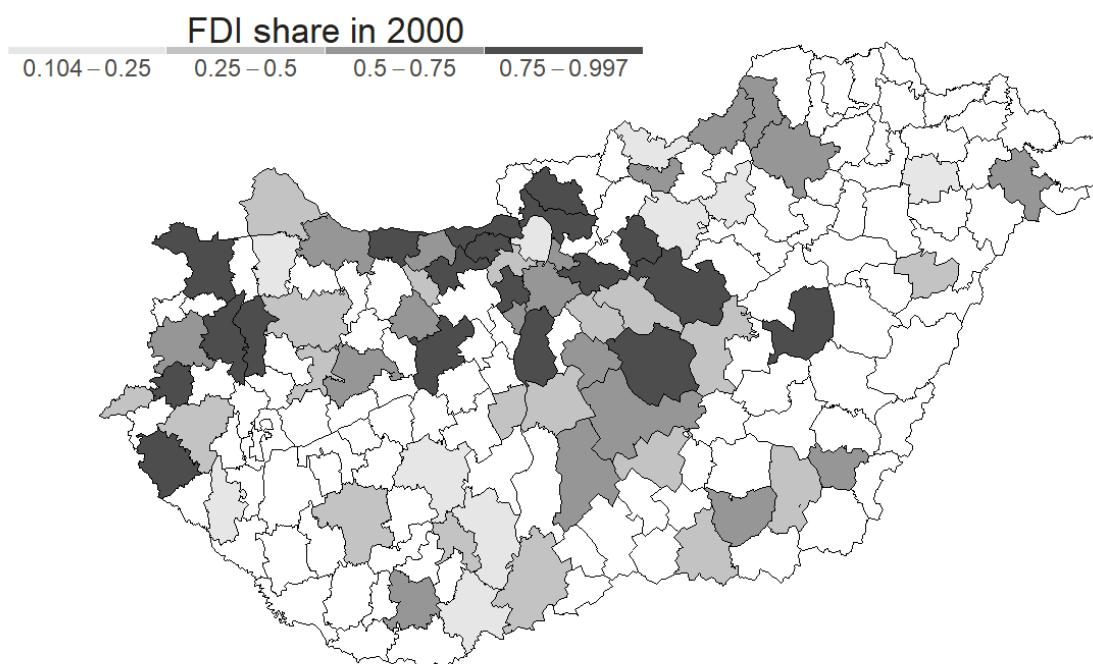
Appendix 4. Transition from short-term (1-year) to long-term (10-year) structural change by agent type.



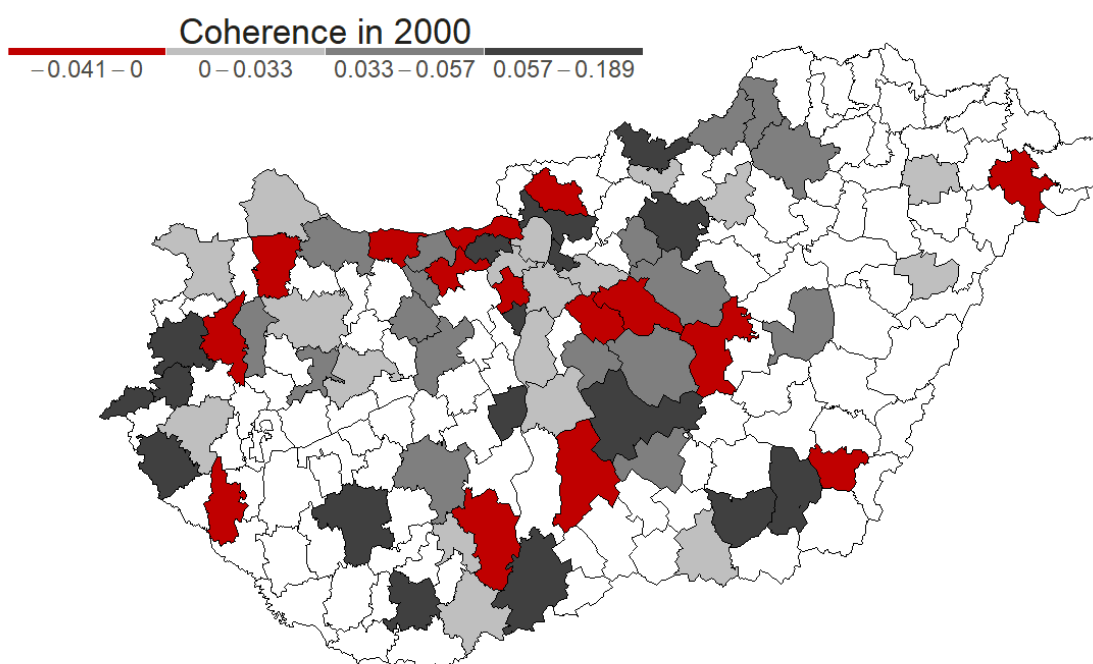
Notes: **(A)** Domestic entry. **(B)** Domestic growing incumbent. **(C)** Domestic declining incumbent. **(D)** Domestic exit. **(E)** Foreign entry. **(F)** Foreign growing incumbent. **(G)** Foreign declining incumbent. **(H)** Foreign exit. The red dashed line indicates the average distance of agent types from the region average match value. Values above this line indicate more related (*i.e.* above average) diversification, while values below indicate more unrelated (*i.e.* below average) diversification. Error bars indicate 95% confidence intervals.

Appendix 5. FDI and coherence in sample regions in 2000.

(A)

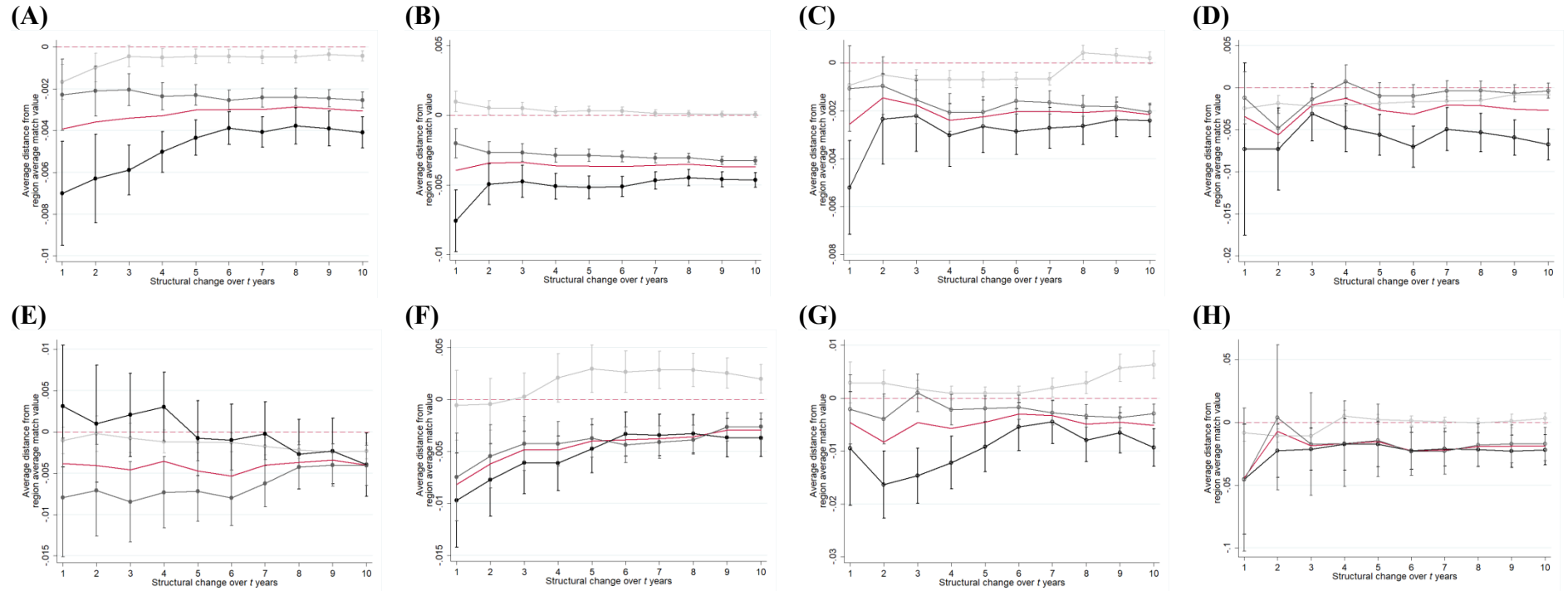


(B)



Notes: (A) The share of FDI in total equity capital stock in 2000. (B) Regional coherence values in 2000. White fill indicates regions not included in the analysis.

Appendix 6. Transition from short-term (1-year) to long-term (10-year) structural change by agent type, decomposed by region group.



Notes: (A) Domestic entry. (B) Domestic growing incumbent. (C) Domestic declining incumbent. (D) Domestic exit. (E) Foreign entry. (F) Foreign growing incumbent. (G) Foreign declining incumbent. (H) Foreign exit. The red dashed line indicates the average distance of agent types from the region average match value. Values above this line indicate more related (*i.e.* above average) diversification, while values below indicate more unrelated (*i.e.* below average) diversification. Error bars indicate 95% confidence intervals. The red solid line represents the average structural change for the whole set of regions induced by the agent type; black lines and error bars represent the *manufacturing integration zone*, dark grey lines and error bars depict the *peripheral regions*, while light grey lines and error bars indicate the *capital city*.